



Leveraging Thousands of Contrail Observations from GLOBE Citizen Scientists



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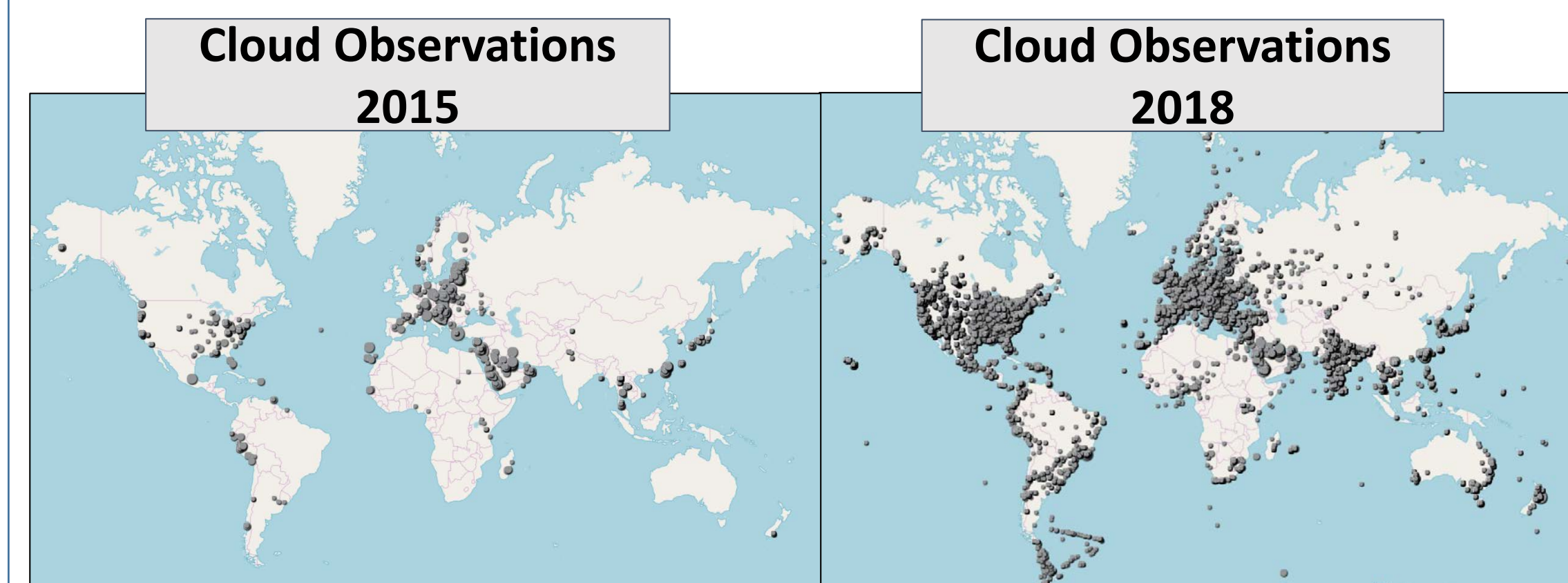
What is GLOBE?

The GLOBE Program is **NASA's largest and longest lasting citizen science program about the Earth**. The GLOBE Program began on Earth Day 1995 and for nearly 25 years has invited students in countries around the world to collect cloud and other environmental observations. In 2017, the program debuted the GLOBE Observer mobile app to engage the wider public, including GLOBE alumni (adults who previously participated in GLOBE as students), in the collection of data using a mobile device.

GLOBE Program is composed of:

- 123 countries
- 34,000 schools
- 142,000 citizen scientists
- 400+ publications

The GLOBE Program: Global Learning and Observations to Benefit the Environment



Impact of data density from the release of the GLOBE Observer mobile app.

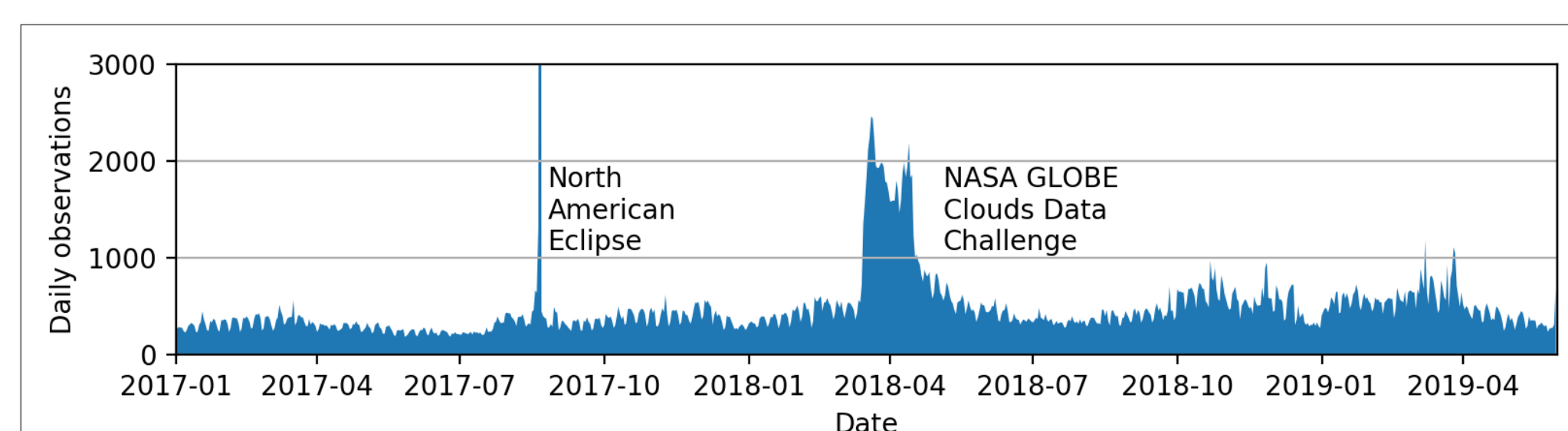
GLOBE Cloud Observations

Observations are collocated with satellite data from the CERES instrument onboard Terra and Aqua, or to Geostationary satellites, or to CALIPSO



Total Cloud Observations since 2017: 500,000+
Total Satellite Matched Observations: 300,000+ (60%)
Total Contrail Observations: 147,000+

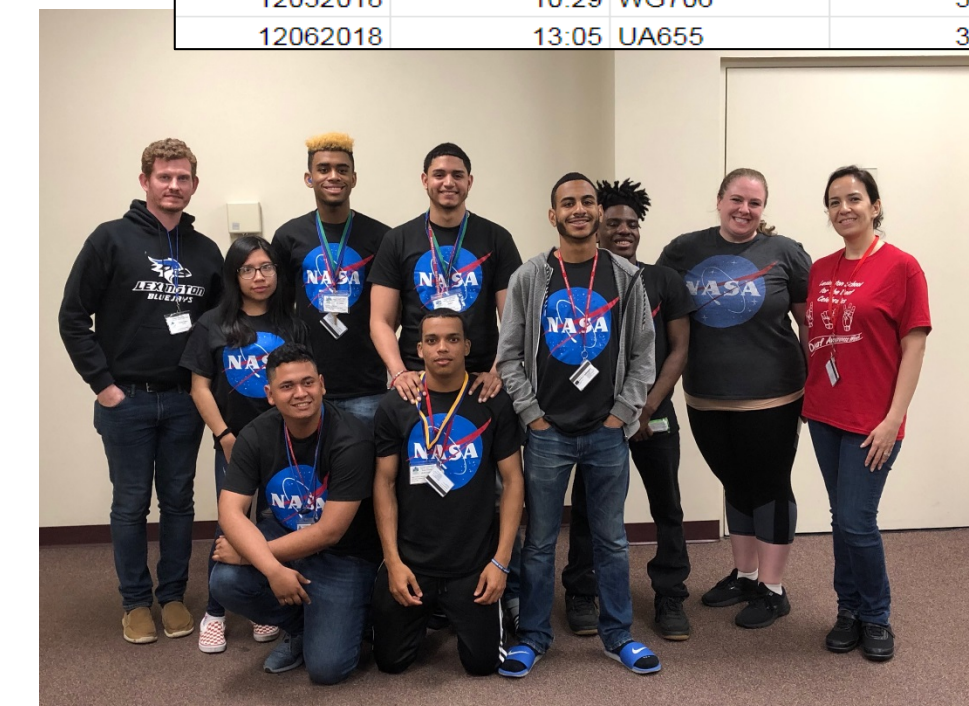
- Short Lived: 38,067
- Persistent, non-spreading: 70,313
- Persistent, spreading: 39,272



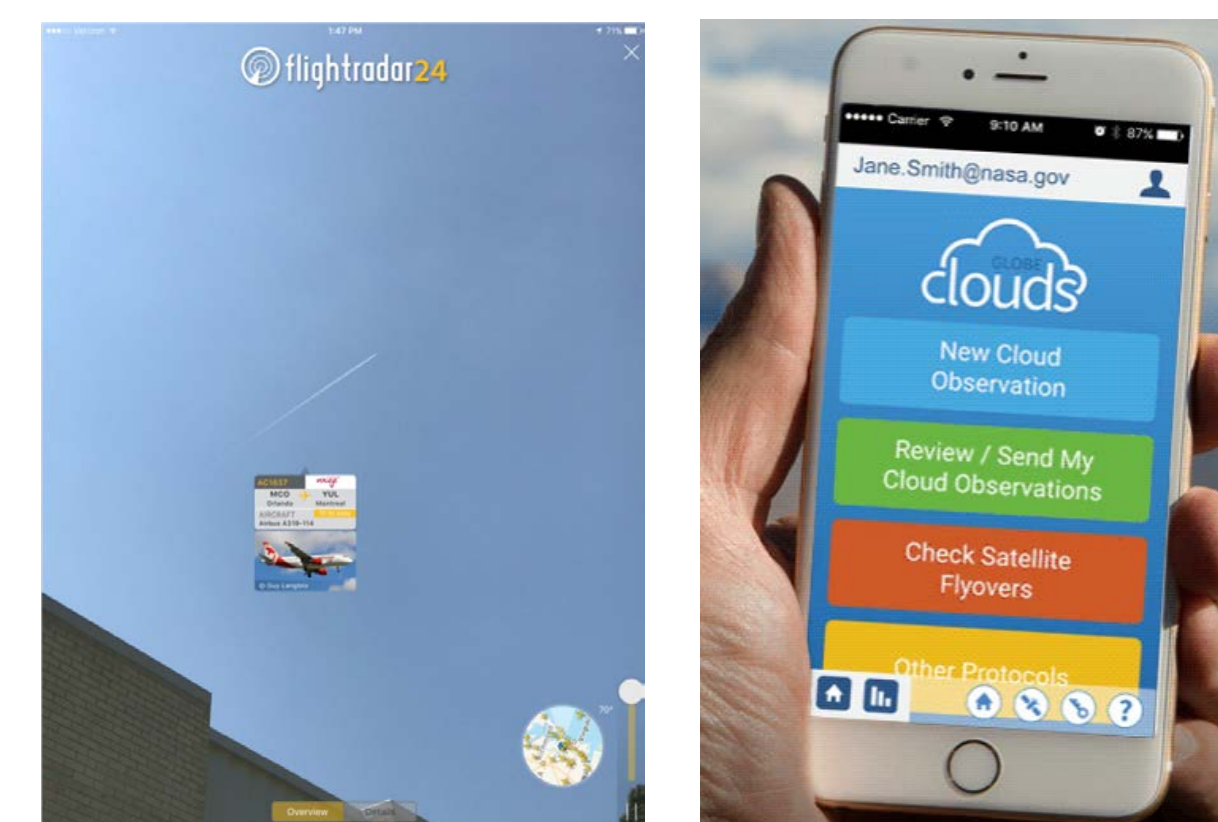
Contrails Investigations Project

Track which airplanes are or are not creating contrails

| Date | Local Time | Airplane Type | Airplane Calibrated Altitude or Height (ft) | Airplane Track (degrees) | Contrail Type |
|--|--|--|---|--|--|
| Example for August 29, 2018 | Example 10:49am | Example E75L | Example 16,000 | Example 28 | No contrail |
| (Value should match the time of cloud observations entered in GLOBE) | (Value should match the time of cloud observations entered in GLOBE) | (Please include those that produce and do not produce contrails) | (Use the app to get this information) | (Use the app; Value should be between 0-359) | (Click on the arrow and choose one of the options) |
| 10032018 | 13:54 | DL1859 | 16,000 | 163 | No contrail |
| 10032018 | 14:03 | AAL18 | 17,404 | 167 | No contrail |
| 11082018 | 13:18 | CRJ7 | 27,000 | 63 | No contrail |
| 12032018 | 10:25 | A320 | 36,000 | 231 | S or short-lived |
| 12032018 | 10:29 | WG706 | 35,000 | 143 | S or short-lived |
| 12062018 | 13:05 | UA655 | 33,000 | 50 | S or short-lived |



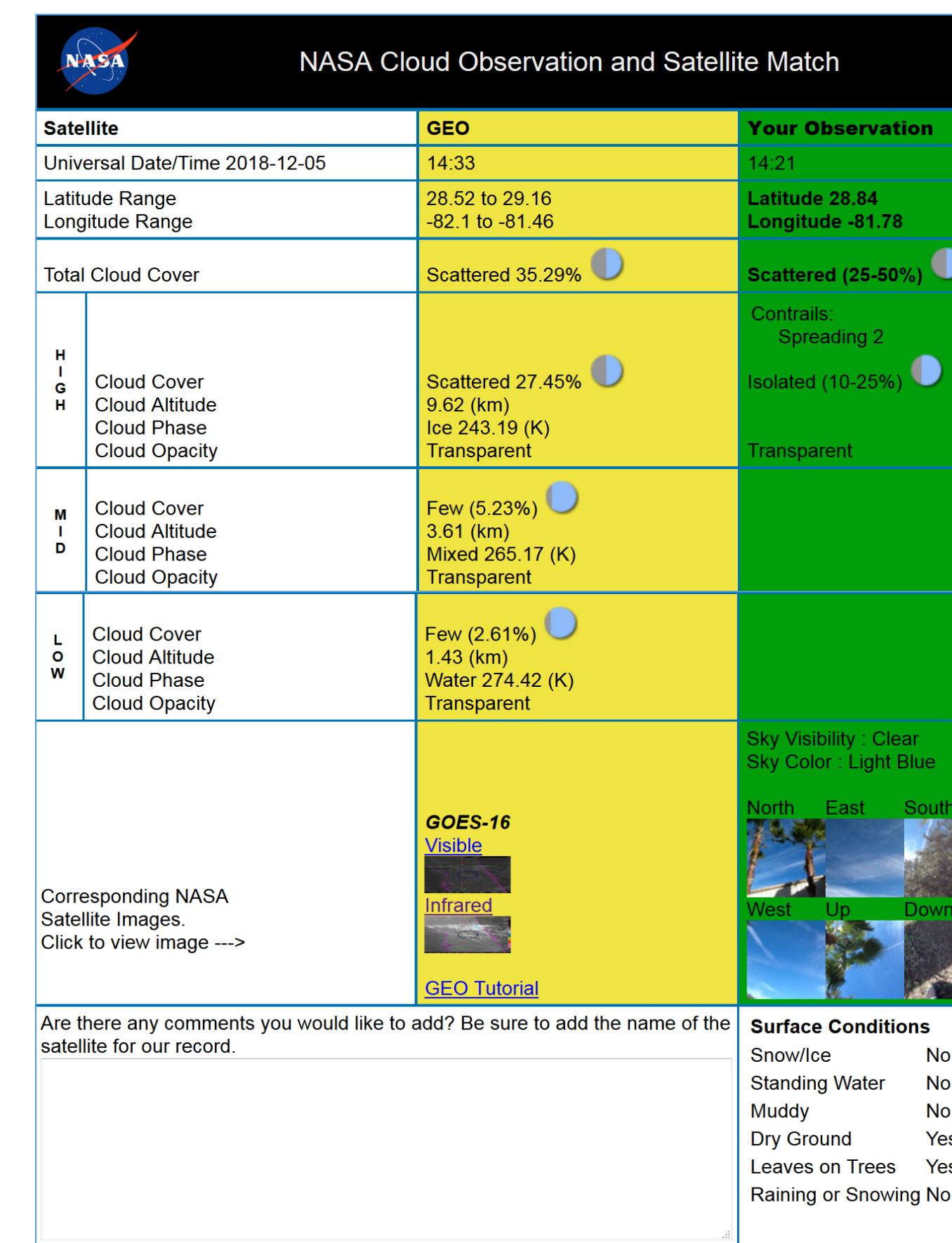
Flight observations courtesy of Lexington School for the Deaf (presented at 2019 GLOBE Northeast SRS)



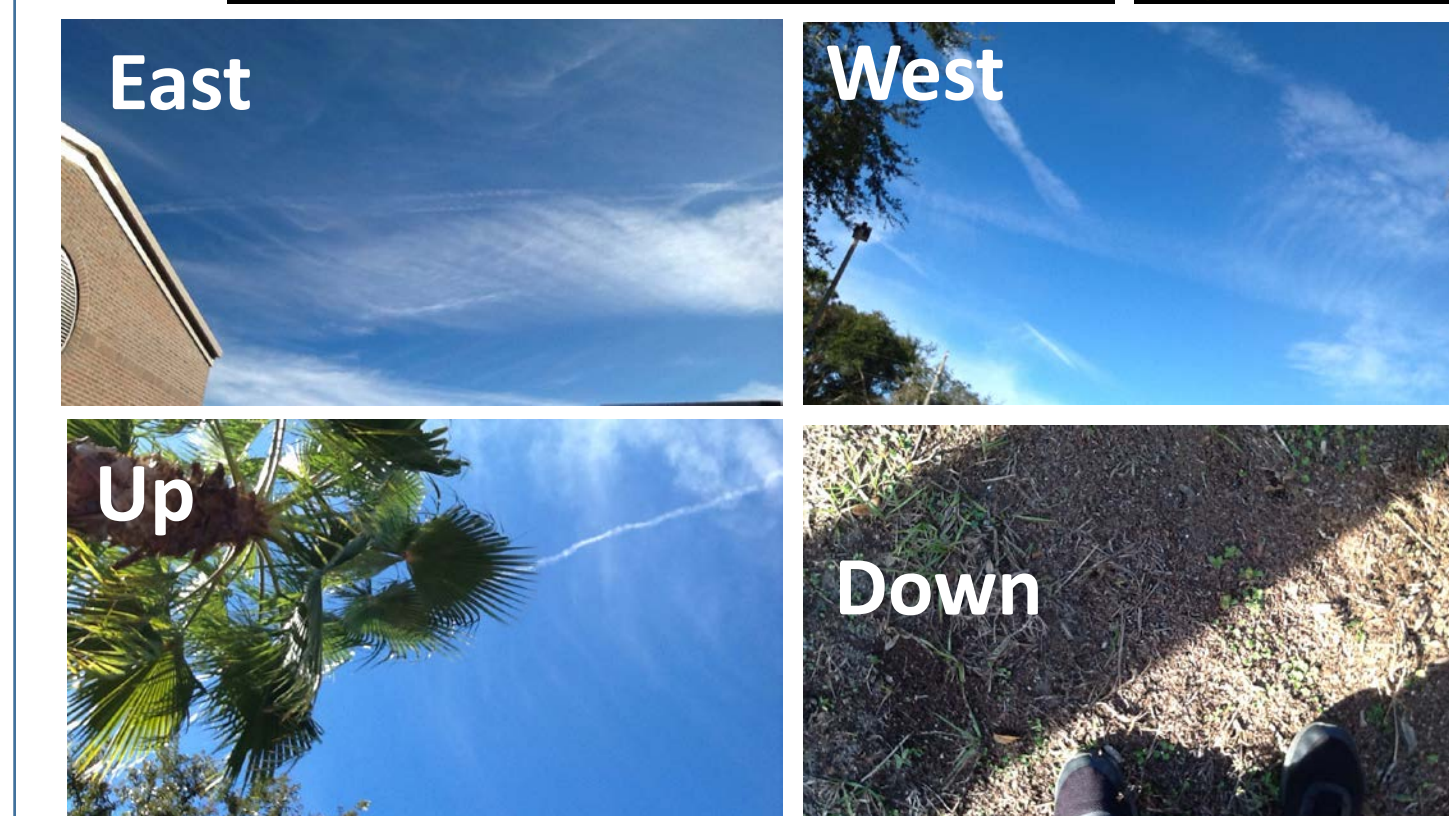
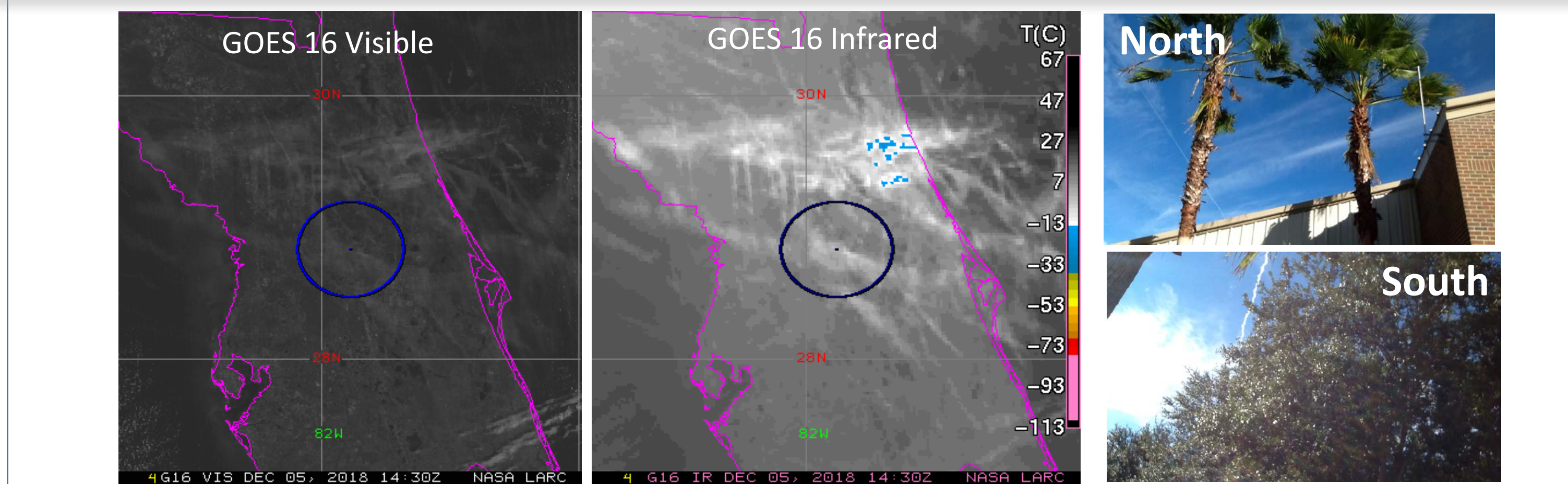
Step 1: FlightRadar24 for airplane info

Step 2: Report contrails via GLOBE

A handful of schools are participating of this project, using the FlightRadar24 app (<https://www.flightradar24.com/>) to find airplanes in their area, record the airplane type, cruising altitude, and track. Students then note if the airplane is creating or NOT creating a contrail and report this using the GLOBE Observer app. The citizen science observations are then collocated with satellite data from the CERES instrument onboard Terra and Aqua, or to Geostationary satellites, or to CALIPSO to provide insight into the impact of commercial aviation on contrail formation and local atmospheric conditions during contrail formation

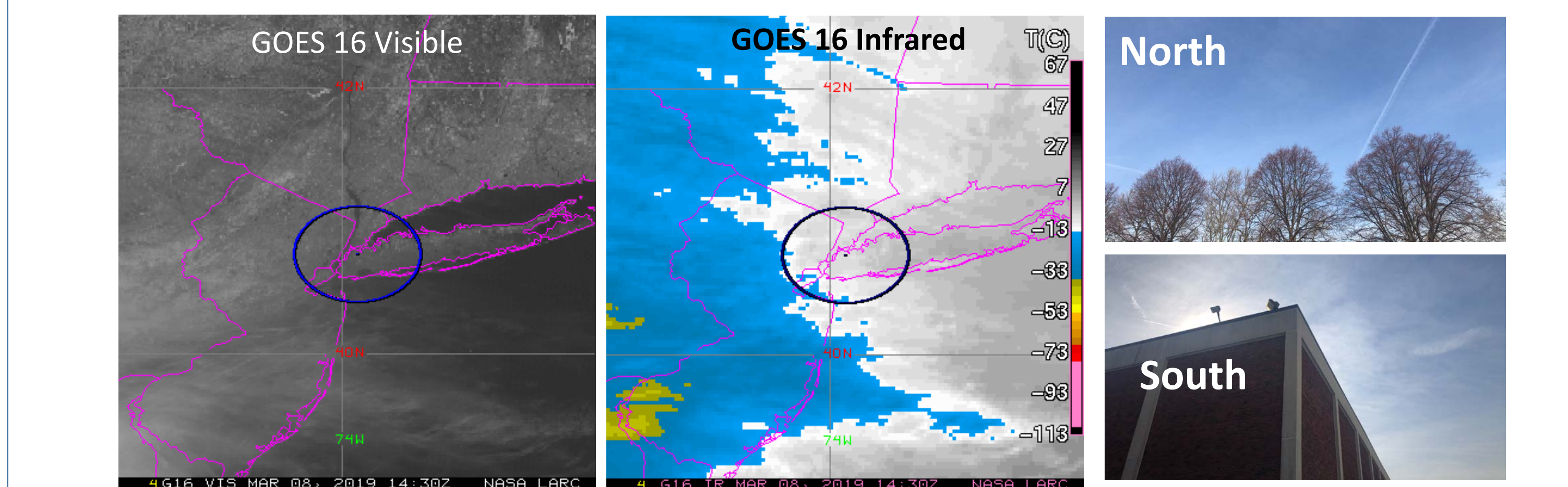


Sample Satellite Collocated Data



Date: 12/5/2018 14:33 UTC

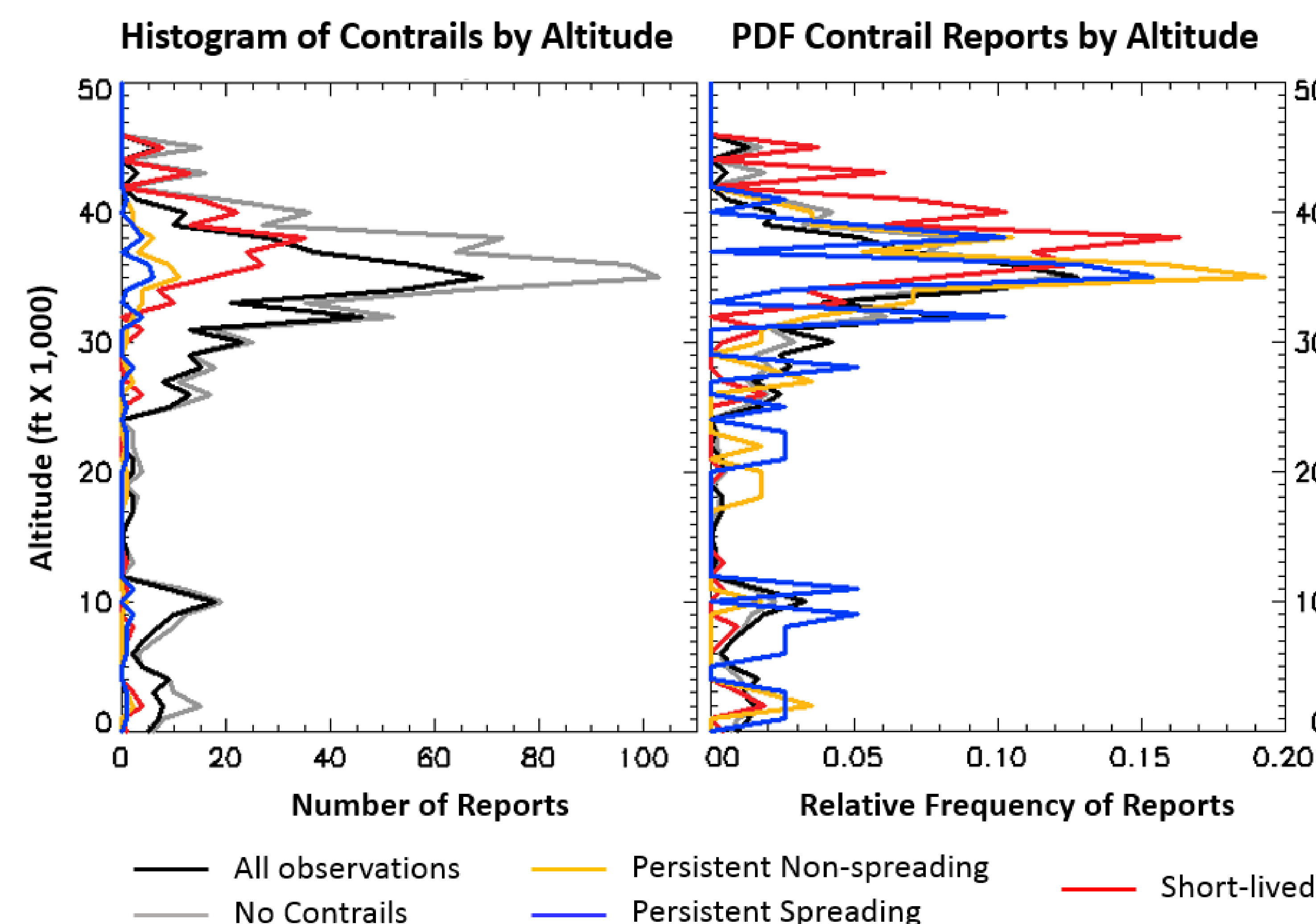
| Airplane Type | Airplane Height | Track | Contrail Type |
|---------------|-----------------|-------|----------------------|
| GLF6 | 36,000 | 9 | Persistent Spreading |
| A320 | 35,000 | 170 | Persistent Spreading |



Date: 3/8/2019 14:33 UTC

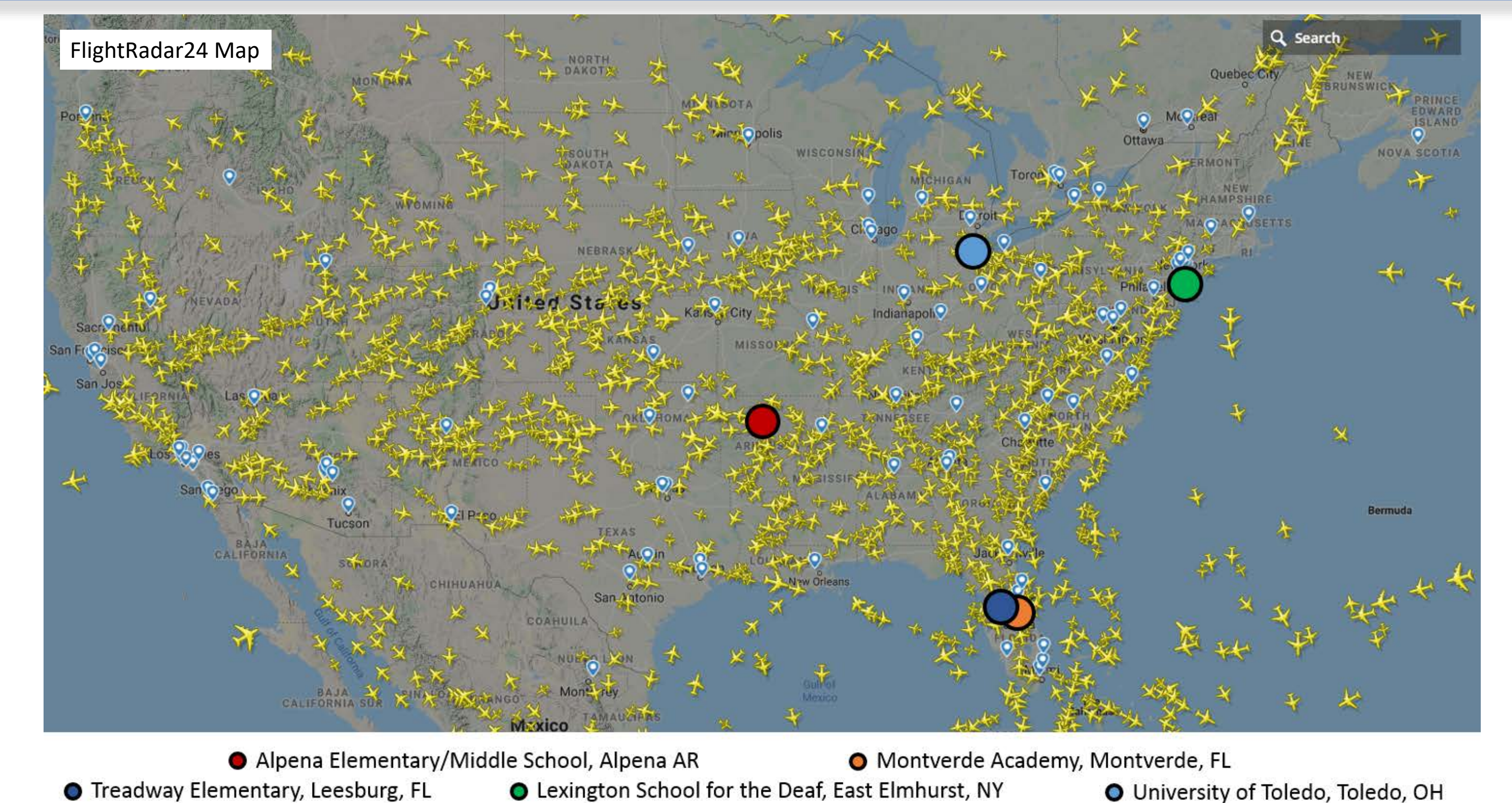
| Airplane Type | Airplane Height | Track | Contrail Type |
|---------------|-----------------|-------|---------------|
| B738 | 35,000 | 141 | Persistent |

Summary of Observations



Summary of observations collected June 2018 – October 2019.

Schools Taking Contrail and Airplane Observations



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